

Part VII

Project Management

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Chapter 15

Project Management

This chapter describes the mission, scope, participation and management roles of the BTeV Project Office. It presents the Work Breakdown Structure of the detector part of the BTeV Project through Level 3. It also represents some of the key procedures and practices that will be followed throughout the course of the project.

15.1 The BTeV Management Task

For the purposes of defining a task-oriented Work Breakdown Structure related to overall project management, we created a model of management, which involves the following activities, grouped as WBS 1.11:

- 1.11.1 Reviews
- 1.11.2 Reports
- 1.11.3 Site visits
- 1.11.4 Management Contact/Local Supervision
- 1.11.5 Technical Board (see below) meetings
- 1.11.6 Standards Preparation
- 1.11.7 Budget Preparation/tracking/adjustment
- 1.11.8 Schedule Preparation/tracking/adjustment
- 1.11.9 Change control
- 1.11.10 Project Management Software and Hardware
- 1.11.11 Administrative and Clerical Support

1.11.12 Review and acceptance of plans/procurements/etc

1.11.13 Personnel Development

1.11.14 Attendance at Key Meetings

These are discussed below.

15.2 BTeV Project Office and Overall Project Management

The BTeV Project Office maintains oversight of the whole BTeV project. The head of the Project Office is the BTeV Project Manager or co-managers. He/she/they are ultimately responsible to the Fermilab Director for completing the scope of the project on schedule and within the budget. The staff of the Project Office provides management, technical and administrative support to assist the BTeV Project Manager in accomplishing his/her task.

The detector part of the BTeV Construction Project consists of nine subprojects that include the detector elements, the trigger, and the data acquisition system and a tenth “detector integration” activity. The overall BTeV Project Management task is organized as the eleventh task, under BTeV WBS 1.11.

The BTeV detector is a “forward” collider detector and as such consists of several relatively independent pieces each occupying a separate longitudinal space in the detector hall. This provides a certain degree of independence among the subprojects that can be exploited to simplify the management of the overall detector project. As much as possible, the Level 2 managers are given the responsibility and the authority to manage their portion of the overall project. Thus, in the detector construction project, each subtask also has its own management section and its own “Project Management Plan”, which is required to be consistent with overall BTeV management standards and practices. The BTeV Project Manager and the Project Office are responsible for providing oversight of the individual subprojects and for providing coordination, integration, and problem resolution for the project as a whole.

From another perspective, the BTeV Project uses resources from several universities in the US and elsewhere, Fermilab, and other national labs in the US and elsewhere. The Project Leader must also interact with, coordinate and provide oversight to all these institutions. The Project Leader is also responsible for communicating with the BTeV Experiment through its spokespersons.

The relationships among the various management and oversight entities, including the funding agencies, the Fermilab management, Fermilab Divisions and sections, and universities and other laboratories participating in the project are described in the BTeV Project Management Plan (PMP) [1] and the BTeV Project Execution Plan (PEP) [2].

15.2.1 Composition and Mission of the Project Office

The staff of the Project Office will consist of



Figure 15.1: The BTeV Project Office

- Project Manager(s) (1 or 2, probably physicists)
- Deputy Project manager (probably an engineer)
- Project Mechanical Engineer
- Project Electronics Engineer
- Project Software Engineer
- Budget Officer
- Safety Officer
- Scheduler
- Project Administrative Support (An Administrative Assistant)
- Secretarial Support (A secretary)
- Integration Physicist
- (possibly a Process/QA engineer)

Some of these positions do not require staffing for the full duration of the project. The Project Office is shown in Fig. 15.1.

15.2.2 Functions of the Project Management Office

The basic functions of the Project Office fall into four general categories:

- oversight/reporting;
- technical assistance, problem resolution;
- management/leadership; and
- administrative support.

Oversight/reporting includes, but is not limited to:

1. developing and maintaining the Work Breakdown Structure and baseline resource loaded cost and schedule;
2. tracking the status of the project relative to the baseline using formal project management tools such as earned value and schedule variance;
3. providing regular (periodic) and ad hoc reports on the status of the project to Fermilab management and the funding agencies;
4. reporting on the status of the project to the BTeV experimental collaboration;
5. developing and maintaining a Project Management Plan and working with the DOE BTeV Program Director to develop and maintain the Project Execution Plan, Acquisition Execution plan, and other formal plans;
6. developing and maintaining a Quality Assurance Program (QAP);
7. preparing annual budget requests and establishing work plans;
8. negotiating Memoranda of Understanding (MOUs) and Statements of Work (SOWs) with all participating institutions;
9. reporting schedule and cost variances and developing mitigation plans;
10. developing, maintaining, and updating the Risk Analysis and Risk Mitigation plan; and
11. managing the change control process.

Technical Assistance and Management/Leadership includes, but is not limited to:

1. developing, selecting, or organizing the development of standards and procedures, captured in documents, for use in the BTeV project and enforcing adherence to them;

2. ensuring that all work done by the subprojects meets the technical requirements, conforms to safety requirements, and satisfies the quality assurance criteria of DOE, Fermilab, and BTeV. This includes visiting production sites at universities, vendors, and other labs;
3. approving, after evaluation and review, all major procurements and contracts;
4. identifying possible conflicts between projects and resolving them;
5. evaluating or arranging to have evaluations made of proposed changes to the technical baseline, cost or schedule and providing the technical input to the change control process;
6. identifying resource shortfalls and reallocating human resources or funds in a manner required to maintain the schedule and budget;
7. appointing the Level 2 subproject leaders and ensuring that the leadership of the subprojects is functioning at an acceptable level;
8. organizing “internal” reviews and responding to their findings; and
9. participating in and responding to the findings of external reviews

Administrative Functions of the Project Office include but are not limited to:

1. preparing and distributing reports;
2. arranging and accounting for travel;
3. maintaining key schedules and scheduling key meetings;
4. providing support for meetings;
5. maintaining general office supplies and equipment;
6. procuring computers, PC software, and general software;
7. evaluating, selecting, acquiring and supporting special project management and report preparation software;
8. supporting guests and visitors, including helping them with travel, housing, support, and workspace;
9. organizing training; and
10. providing administrative support for internal and external reviews.

The BTeV Project Office will reside in the Particle Physics Division(PPD). The relation between the PPD and the BTeV project is described in the PMP. Other Fermilab divisions and sections, including Computing Division, Beams Division, Technical Division, Facility Engineering Systems Section (FESS), and Business Systems Section (BSS) are involved in BTeV. The interaction of those divisions with the project is described on the PMP.

15.2.3 Key Roles in BTeV Project Management/Project Office

The organization of the BTeV Project Management Task is defined by the Work Breakdown Structure, WBS 1.11, shown above. The key management roles are described here. By "role" we mean a part in the task that may be carried out by one or more persons. It is understood that in BTeV, people may have more than one role (and will therefore have only a fraction of their effort committed to a particular role in the Project Management Task). For example, an engineer may work on more than one task. It is also understood that, in some cases, more than one person may play any given role. For example, there could be co-leaders for some tasks or subtasks, including BTeV Project Manager.

15.2.3.1 Appointment to the BTeV Project Office

The BTeV Project Manager(s) is appointed in a manner set forth in the PMP. All other appointments will be made by the BTeV Project Manager(s), with additional approvals and concurrences as specified in the PMP. In some cases, the concurrence of the BTeV spokespersons may also be required. Appointments are typically for two-year terms and are renewable.

15.2.3.2 BTeV Project Manager (WBS Level 1 Task Manager)

The BTeV Project Manager is ultimately responsible to the Fermilab Director for completing the scope of the project on schedule and within the budget. The responsibilities and the method and duration of appointment of the BTeV Project Manager are described in the PEP and PMP. The BTeV Project Office supports the activities of the Project Manager to accomplish his/her mission and is, effectively, his/her staff.

15.2.3.3 BTeV Deputy Project Manager

The method of appointment of the BTeV Deputy Project Manager is specified in the PEP and PMP. The BTeV Deputy Project Manager assists and stands in for the BTeV Project Manager and carries out other tasks as assigned by the Project Manager.

15.2.3.4 BTeV Project Mechanical Engineer

The BTeV Project Mechanical Engineer is appointed by the BTeV Project Manager, with the concurrence of the BTeV spokespersons and others specified in the PMP, on a renewable

term basis. He/she reports to the BTeV Project Manager. He/she advises the Project Manager on all issues connected to the mechanical design and realization of the BTeV detector. He/she also advises and works with all participants in BTeV mechanical work to ensure that each system achieves its requirements within budget and on schedule. This includes responsibility for setting standards, organizing reviews of key designs, fabrication, source selection, and procurements, establishing procedures for testing, integration, and commissioning of all mechanical components, etc. The BTeV Project Mechanical Engineer is responsible for defining BTeV mechanical standards, including those involving drawings and quality assurance, ensuring all mechanical work in BTeV adheres to BTeV mechanical standards, for ensuring complete documentation of the systems to facilitate assembly, integration, and maintenance, and for ensuring adherence to all ES&H standards. The BTeV Project Mechanical Engineer will assist in the supervisory, scheduling, budgeting and oversight roles in the area of mechanical work for the BTeV Project.

15.2.3.5 BTeV Project Electronics Engineer

The BTeV Project Electronics Engineer is appointed by the BTeV Project Manager, with the concurrence of the BTeV spokespersons and others specified in the PMP, on a renewable term basis. He/she reports to the BTeV Project Manager. He/she advises the Project Manager on all issues connected to the electronic/electrical design and realization of the BTeV detector. He/she also advises and works with all participants in BTeV electronics/electrical work to ensure that each system achieves its requirements within budget and on schedule. This includes responsibility for setting standards, organizing reviews of key designs, fabrication or procurements, establishing procedures for testing, integration, and commissioning of all electronics and electrical components and subsystems, etc. The BTeV Project Electronics Engineer is responsible for defining BTeV electronics standards, including those involving quality assurance, ensuring all electronics/electrical work in BTeV adheres to BTeV electronics standards, for ensuring complete documentation of the systems to facilitate assembly, integration, and maintenance, and for ensuring adherence to all ES&H standards. The BTeV Project Electronics Engineer will assist in the supervisory, scheduling, budgeting and oversight roles in the area of electronics/electrical work for the BTeV Project.

15.2.3.6 BTeV Project Software Engineer

The BTeV Project Software Engineer is appointed by the BTeV Project Manager, with the concurrence of the BTeV spokespersons and others specified in the PMP, on a renewable term basis. He/she reports to the BTeV Project Manager. He/she advises the Project Manager on all issues connected to the software and computing issues in the design and realization of the BTeV detector. He/she also advises and works with all participants in BTeV involved in software and computing work to ensure that each system achieves its requirements within budget and on schedule. This includes responsibility for setting standards, organizing reviews of key designs and codes, and realization, establishing procedures for testing, integration, and commissioning of all software with their electronics subsystems, etc. The BTeV Project

Software Engineer is responsible for defining BTeV software standards, including those involving quality assurance, ensuring all software work for the BTeV detector construction adheres to BTeV software standards, for ensuring complete documentation of the systems to facilitate development, debugging, integration, and maintenance, and for ensuring adherence to all ES&H standards. The BTeV Project Software Engineer will assist in the supervisory, scheduling, budgeting and oversight roles in the area of software and programming work for the BTeV Project.

15.2.3.7 BTeV Integration Physicist

The BTeV Integration Physicist is appointed by the BTeV Project Manager, with the concurrence of the BTeV spokespersons and others specified in the PMP, on a renewable term basis. He/she reports to the BTeV Project Manager. He/she advises the Project Manager on all issues connected to integration issues in the design and realization of the BTeV detector. He/she also advises and works with all participants in BTeV on integration issues to ensure that each system achieves its requirements within budget and on schedule. This includes responsibility for making sure that integration issues are properly taken into account in all standards and reviewing key designs, and their implementation to ensure that integration issues are considered. He/she is responsible for helping to develop the integration and commissioning plans for the detector. The BTeV Integration Physicist will assist in the supervisory, scheduling, budgeting and oversight roles in the area of integration for the BTeV Project

15.2.3.8 BTeV Scheduler

The BTeV Scheduler works with the Project Management and the subproject managers to develop the BTeV schedule and to track it and to make changes when necessary. He/she is responsible for providing regular and extraordinary reports concerning the progress of the project and identifying potential problems and reporting them to the project management.

15.2.3.9 BTeV Budget Officer

The BTeV Budget Officer works with the Project Management and the subproject managers to develop the BTeV budget and to track it and to make changes when necessary. He/she is responsible for providing regular and extraordinary reports concerning the cost of the Project and identifying potential problems and reporting them to the Project Management.

15.2.3.10 BTeV Administrative Support

BTeV Administrative support provides assistance to the BTeV Project Manager and staff in carrying out their mission. This will include assistance with report preparation, documentation, travel arrangements, support for visitors, support for reviews, etc.

15.2.3.11 Safety Officer

The Safety Officer will ensure that all systems will be designed and implemented in compliance with Fermilab's ES&H policies. Where necessary, the Safety Officer will augment these standards by developing and enforcing BTeV-specific ES&H practices and policies. All supporting documents and records of tests, calculations, and studies relating to safety issues, including operations, will be provided as part of the deliverables of the BTeV Task.

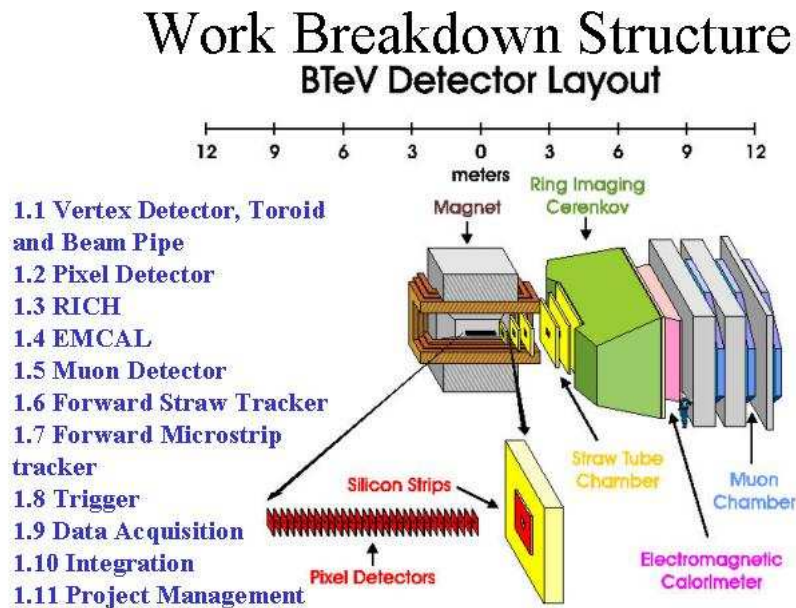
15.2.4 BTeV Technical Board

The BTeV Technical Board advises the BTeV Project Manager on all issues related to the BTeV project. Membership consists of all Level 2 Project Managers, the Deputy Project Manager, the Project Engineers, the Integration Physicist, the BTeV Spokesperson(s), the Budget Officer, Scheduler, Safety Officer, and a number of at large senior members of the BTeV collaboration. Meetings occur roughly biweekly and are chaired by the Project Manager or designee. The BTeV Technical board also serves as a forum for communication, interchange of ideas, and coordination. All major changes to design that could affect more than one system must be brought before the Technical Board. The Technical Board is also involved in evaluating changes to the design, implication, scope, etc. It is also involved in discussing resource shortfalls and imbalances. Technical Board conclusions take the form of recommendations to the Project Manager.

15.3 BTeV Detector Work Breakdown Structure

The task-oriented Work Breakdown Structure for the BTeV Detector is one of three Level 1 parts of the BTeV Project. The WBS for the BTeV Detector part of the project is shown here:

- 1.1** Magnets, Toroids, and Beampipes
- 1.2** Pixel Detector
- 1.3** Ring Imaging Cherenkov Counter (RICH)
- 1.4** Electromagnetic Calorimeter (EMCAL)
- 1.5** Muon Detector
- 1.6** Forward Straw Tracker
- 1.7** Forward Silicon Microstrip Tracker
- 1.8** Trigger
- 1.9** Event Readout and Control



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Figure 15.2: The WBS for the BTeV Detector shown with a Schematic of the Detector

1.10 Installation, Integration, and Commissioning

1.11 BTeV Detector Project Management

The BTeV Detector project is one of three Level 1 projects embraced by the full BTeV project. The other two projects are

- the construction, installation and commissioning of the C0 Interaction Region components (WBS 2.0) and
- the outfitting of the C0 Hall and counting room to support the BTeV experiment (WBS 3.0).

The WBS for the BTeV Detector project is shown schematically in association with the detector in Fig. 15.2. More detailed Work Breakdown Structures for the eleven tasks related to the detector are shown graphically in the appendix to this chapter.

This is a large number of subprojects and would make the review and reporting process somewhat cumbersome. To simplify and streamline this, for the purpose of reviews, we think of the BTeV detector effort as divided into four “supergroups”:

- Group 1: Tracking (WBS 1.2, 1.6, 1.7)
- Group 2: Particle ID (WBS 1.3, 1.4, 1.5)

- Group 3: Trigger and DAQ (WBS 1.8, 1.9)
- Group 4: Infrastructure, Integration and commissioning (WBS 1.1, 1.10, 1.11)

Each “supergroup” will have one major internal review per year. The word internal means that the review will report to BTeV management and will be for its use. The reviewers may be drawn from inside or outside the BTeV collaboration. In addition, it is assumed that there will be at least two major external reviews, that is, reviews commissioned by either Fermilab or the funding agencies and which report their results to them.

Our initial model for reporting is to require monthly reports from each Level 2 project. The individual reports are combined, rectified, and checked for accuracy and consistency, augmented with various summary material, rollups and status. These are submitted to the higher levels of management by the Project Manager.

The BTeV Project Manager is advised by a Technical Board that consists of the technical members of the Project Office, the Budget Officer, Scheduler, and Safety Officer, and the Integration Physicist, each Level 2 Project Leader, the BTeV spokespersons, and other ad hoc members as he/she wishes. The Technical Board is a forum for discussions that have the potential to impact more than one subproject, to discuss resource imbalances and methods for addressing them, etc.

Site visits to collaborating institutions will also important elements of management. These will be carried out by an appropriate combination of visits by Level 2 or 3 managers to key sites, with relevant Project Office personnel accompanying them. It is expected that every site will be visited at least once each year.

Vendor visits will generally be the responsibility of the Level 2 Manager whose subproject is responsible for the procurement. However, in cases where major budgetary or schedule issues are involved, he/she should be accompanied by the Project Manager or designee.

BTeV will rely on a complete suite of project management software, which will provide budgetary information, a scheduling program, several project management tools, and report generators. This will enable BTeV to use formal project management procedures to manage the project and formal metrics, such as earned value and schedule variance, to status the project. Arranging for licensing and support of this software will be a responsibility of the Project Office. It is expected that help in this area will be drawn from Fermilab Business Systems staff and Computing Division Staff. Included in this will be the maintenance of an electronic document repository and a World Wide Web site to provide access to information about the project. It is expected that help for this will be drawn from the BTeV collaboration, which already has these facilities.

The software that has been selected for scheduling, costs, and project management is an integrated suite of tools from Welcom, Inc - Open Plan, Cobra and WelcomHome, respectively. Open Plan is used by Level 2 Subproject Managers to schedule their subproject and provide quantity and cost information to Cobra. Cobra outputs project costs with its interface to both Open Plan and the lab’s ORACLE financial databases, owned and maintained by the Business Services Section. WelcomHome is a web-based software tool for monitoring and updating status of activities within the BTeV Project. All levels of management will

use WelcomHome for monitoring purposes. The suite of Welcom project management software tools and the ORACLE Project Accounting tools should allow BTeV Management to efficiently manage the BTeV Project.

15.4 BTeV Management Procedures

15.4.1 Internal Reviews

Internal reviews are a mechanism to bring expertise within BTeV into a particular activity to help guarantee a satisfactory result. Reviews are a mechanism to assist in the elimination of problems and to make sure that interfaces to other activities and tasks are acceptable to the people carrying out those activities. They are intended to be constructive aspects of BTeV project management. Because they take significant time to organize and carry out, they should be undertaken with specific goals in mind and to address specific problems or issues. In some cases, these reviews may invite external consultants but in all cases they submit their results to the BTeV Project Manager and the BTeV spokespersons. Internal reviews may include, but are not limited to:

- Subtask reviews
- Electronics reviews, which may include reviews internal to individual work or subtasks as well as reviews specified by the BTeV Project Management. Examples of the latter kind of reviews might include
 - Interfacing or integration reviews including grounding and shielding reviews.
 - Approval reviews for major chip or board procurements
 - Review of sensor design and procurement
- Software reviews, which may include reviews internal to individual work or subtasks as well as reviews specified by the BTeV Project Management. Examples of the latter kind of reviews might include
 - Software code walkthroughs
 - Reviews of major commercial software procurements or choices of free/shareware software
 - Mock data challenges, for example of the trigger system software.
- Mechanical reviews, for example,
 - Mechanical design and structure reviews
 - Cooling system reviews

- Integration reviews, which are reviews intended to ensure that tasks that must inter-operate do so correctly.
- BTeV Project Reviews, that is participation in project-wide reviews organized by the BTeV Project Manager or the BTeV spokespersons.

15.4.2 BTeV External Review of Project Management

The BTeV Project Office and Management will be reviewed at least annually. Reviews will have a specific, detailed charge and will have a small panel of outside experts who will comment formally on the review and note any problems or areas of concern. The results of the review will be summarized in writing and will be presented to the BTeV Technical Board and BTeV Spokespersons. Serious questions about direction or technical approach will be discussed and resolved by the BTeV Project Manager with the assistance of, and to the satisfaction of, the BTeV Technical Board and Spokespersons.

15.4.3 External Agency or Fermilab Reviews

In addition to the external reviews organized by BTeV, there will be reviews organized by and reporting to external funding agencies and Fermilab. The BTeV Project Manager or the BTeV spokespersons, as appropriate to the particular review, will organize BTeV presentations at these reviews. It will be the role of the BTeV Project Manager to provide the required support for the preparation for the review through the Project Office, to participate as required in the review, and help resolve any issues emerging from the review.

15.4.4 Reporting

The BTeV Project Manager will provide BTeV Spokespersons with contributions for reports which they require or which are required by them for Fermilab or funding agencies. The BTeV Project Manager will develop, in conjunction his or her team, a reporting procedure for the whole project as well as for the Project Office subproject. Such reporting should guarantee good information flow within the project but should require no more effort than is needed to meet this objective.

15.4.5 Assignment of Responsibility for Work

At some point a subgroup or collaborating institution may want (or be required) to formalize its activity and assume responsibility for work on a BTeV subsystem. The work may be an individual subtask or subtask component. Assumption of responsibility for an activity will be done by submitting a formal written proposal to the relevant Level 2 Task Manager. The Task Manager will work with the proponents to develop the final proposal and after the Task Manager approves it, he or she will submit it to the BTeV Project Manager, the BTeV Technical Board, and the Spokespersons for concurrence. After a positive decision, the Task

Manager will negotiate an ‘assignment of responsibility’ for the project or subtask. This agreement with the group will be written and will specify all requirements (performance, interfacing, etc), all deliverables, schedule, costs, and manpower requirements. Deliverables will normally include technical components (with interconnections, power, etc), quality assurance data (results of acceptance tests), test and debugging procedures, supporting computer programs (simulations, readout, diagnostic, monitoring), complete documentation (schematics, trouble-shooting), safety information and procedures, and a maintenance and repair plan. The agreement will also specify commitments to install, debug, integrate, and maintain all devices. The BTeV Project Manager will approve the agreement, with the concurrence of BTeV Technical Board. If required, the agreement will then be submitted to Fermilab and the funding agencies for approval. The agreement must be reflected in the group’s formal MOU and funding and manpower plan. The group will then undertake the subtask. Reports and cost and schedule data will be provided for the regular reports and upon special request. Reviews will be conducted as needed but no less than once per year.

The Level 2 Task Manager must ensure that all work assigned under the Task is being carried out on schedule, within budget, is technically sound and meets the requirements of the project for quality and ES&H. If work is not being done or is not meeting the requirements, action must be taken to correct the situation. If the corrective action requires changes in MOUs or SOWs, the problem must be brought to the BTeV Project Manager for resolution.

Bibliography

- [1] the BTeV Project Management Plan (PMP), under development.
- [2] the BTeV Project Execution Plan (PEP), under development
- [3] the BTeV Work Breakdown Structure
- [4] BTeV Project Management Technical Description, BTeV document, number 1143
- [5] WBS 1.11 BTeV Project Management EXCEL WBS 1.11, BTeV document, number 1200

Appendix

The Work Breakdown Structures for the various Level 2 projects are shown down one or more additional levels in the “organigrams” shown in Fig. 3 through Fig. 13.

Vertex & Toroidal Magnets & Beam Pipe

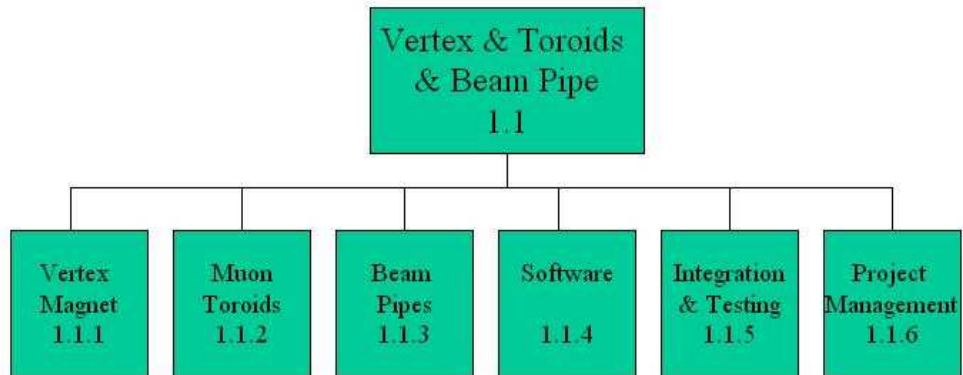


Figure 3: WBS 1.1: Magnets, Toroids, and Beam Pipes

Pixel Detector

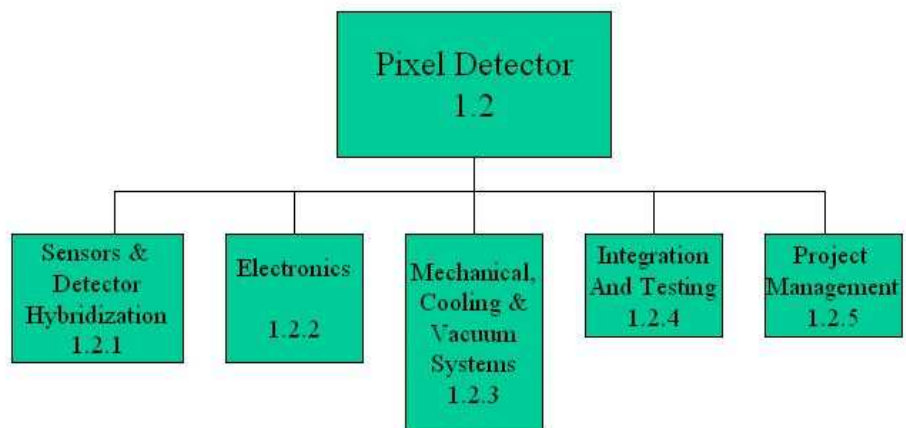


Figure 4: WBS 1.2: Pixel Detector

Ring Imaging Cerenkov Counter

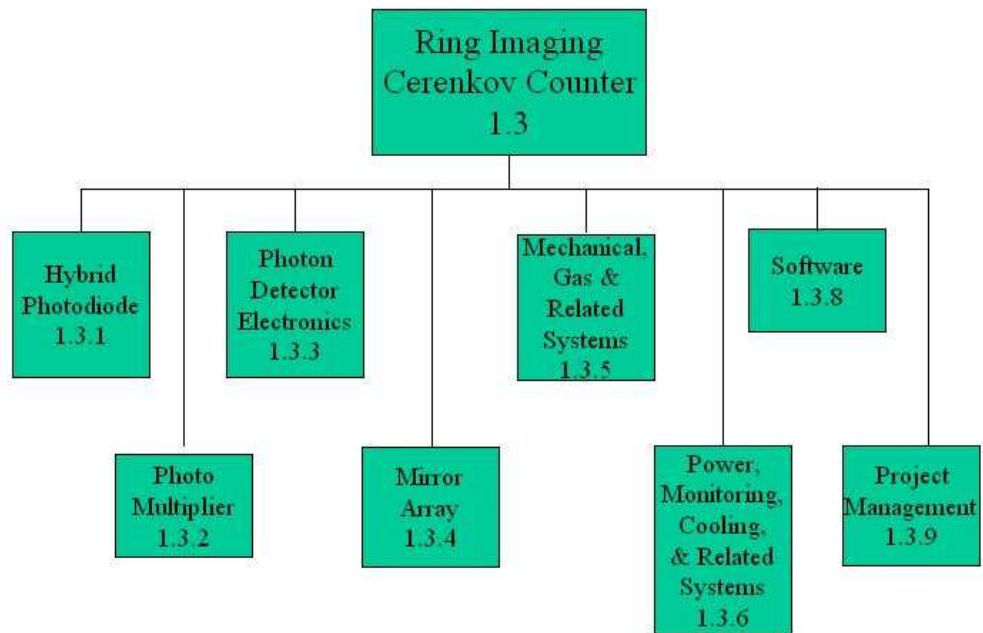


Figure 5: WBS 1.3: Ring Imaging Cerenkov Counter (RICH)

Electromagnetic Calorimeter

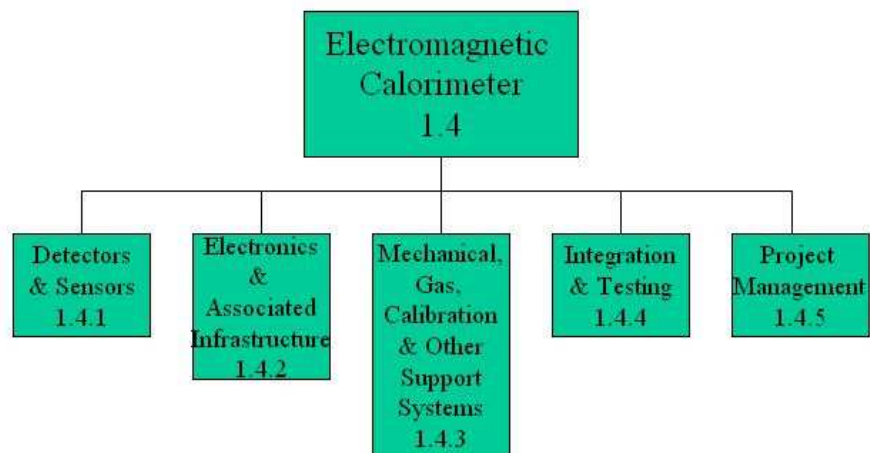


Figure 6: WBS 1.4: Electromagnetic Calorimeter

Muon Detector

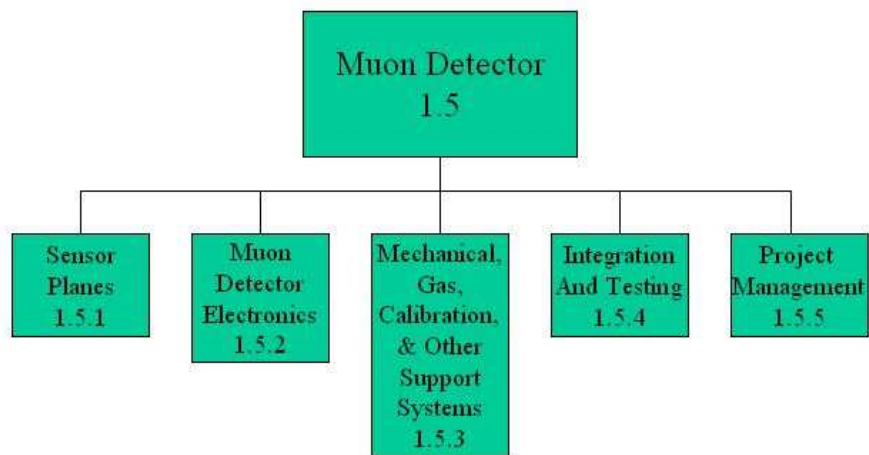


Figure 7: WBS 1.5: Muon Detector

Straw Forward Tracker

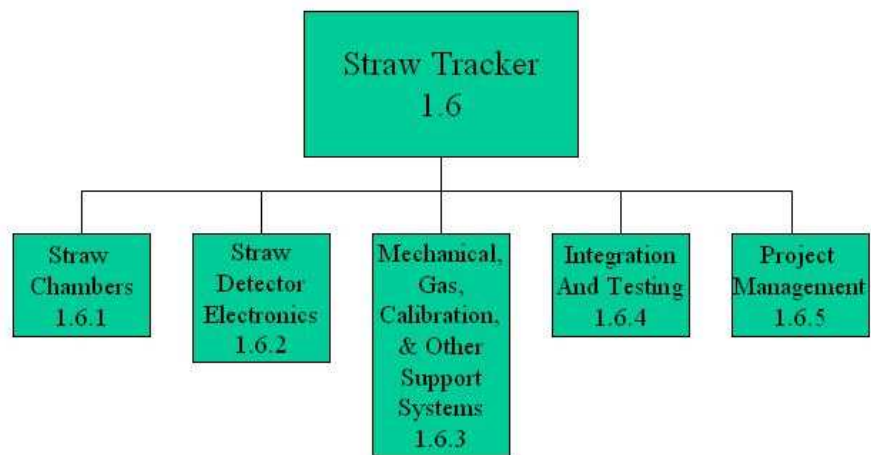


Figure 8: WBS 1.6: Forward Straw Tracker

Forward Tracker Silicon Microstrip Detector

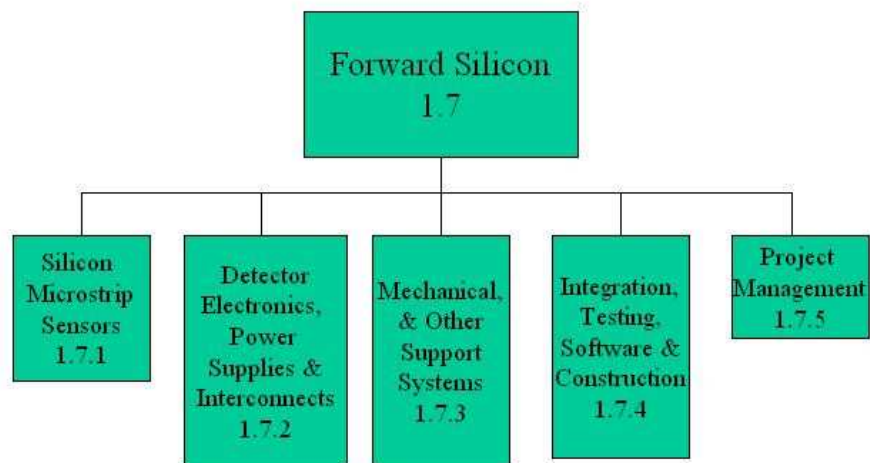


Figure 9: WBS 1.7: Forward Silicon Tracker

Trigger

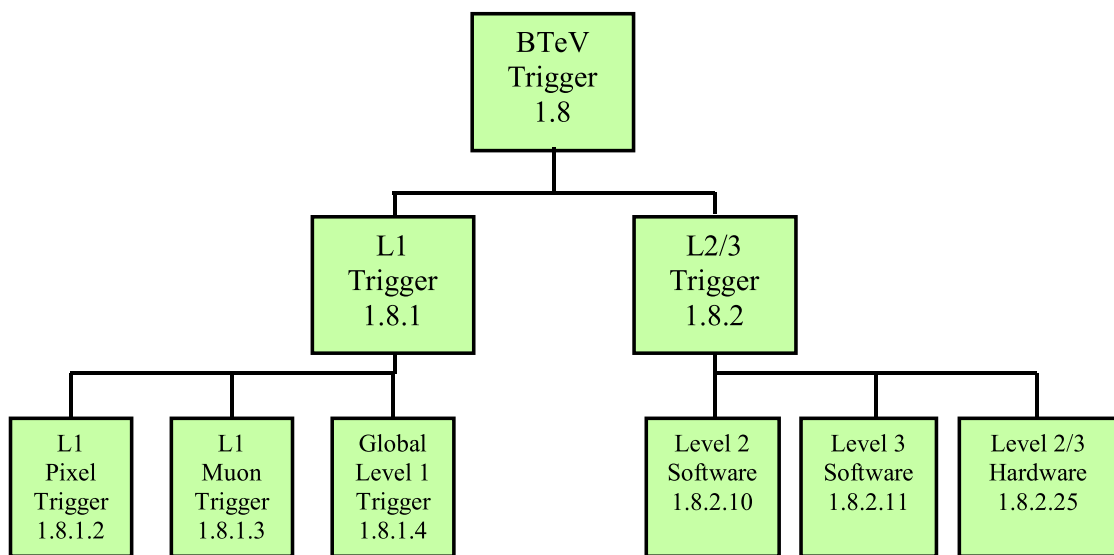


Figure 10: WBS 1.8: Trigger

Event Readout & Controls (DAQ)

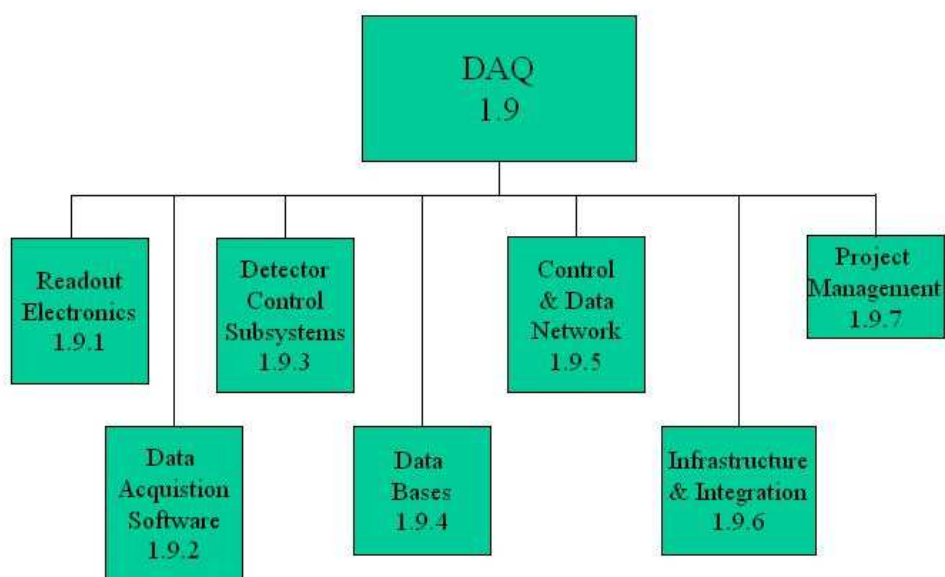


Figure 11: WBS 1.9: Event Readout and Control

System Installation, Integration & Commissioning

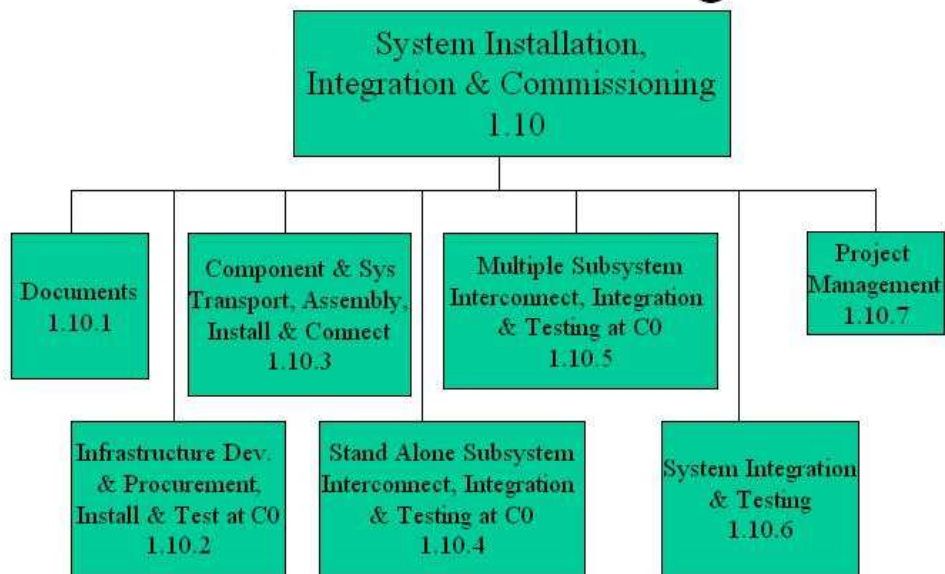


Figure 12: WBS 1.10: Integration, Installation and Commissioning

BTeV Project Management

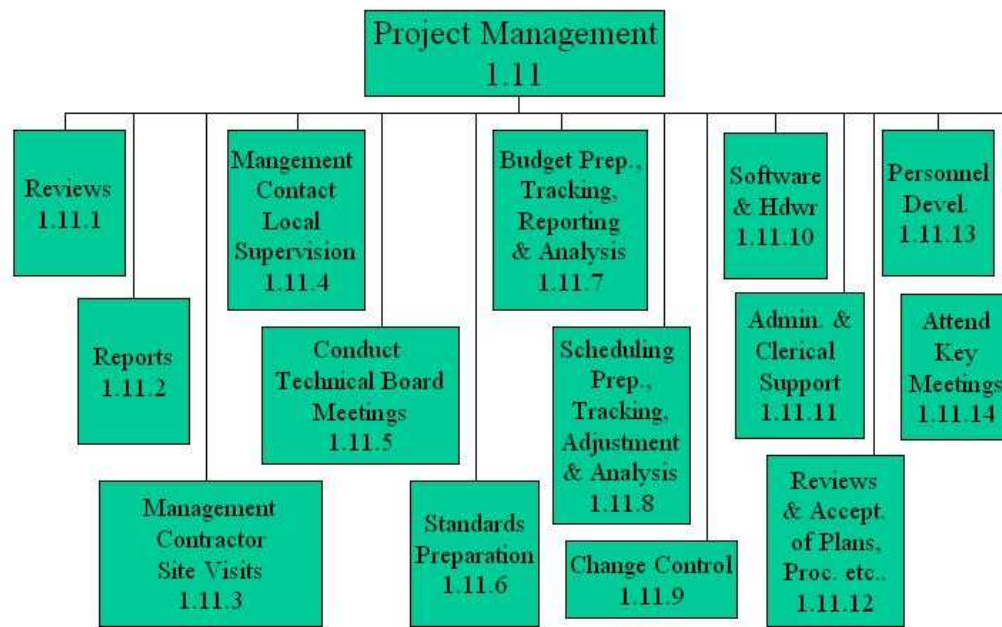


Figure 13: WBS 1.11: BTeV Detector Project Management